



(11) **EP 0 388 936 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention
of the grant of the patent:
11.06.1997 Bulletin 1997/24

(51) Int Cl.⁶: **H04N 5/217, H04N 5/238,
H04N 5/235, H04N 5/232**

(21) Application number: **90105372.8**

(22) Date of filing: **21.03.1990**

(54) **Image pickup device**
Bildaufnahmevorrichtung
Dispositif de prise d'image

(84) Designated Contracting States:
DE FR GB

(30) Priority: **22.03.1989 JP 69655/89**

(43) Date of publication of application:
26.09.1990 Bulletin 1990/39

(73) Proprietor: **MATSUSHITA ELECTRIC INDUSTRIAL
CO., LTD.**
Kadoma-shi, Osaka-fu, 571 (JP)

(72) Inventors:
• **Ishii, Hirofumi**
Moriguchi-shi (JP)

• **Morimura, Atsushi**
540-10, Gakuennaka-4-chome, Nara-shi (JP)

(74) Representative: **Patentanwälte**
Leinweber & Zimmermann
Rosental 7
80331 München (DE)

(56) References cited:
EP-A- 0 332 169 GB-A- 2 164 225
US-A- 4 769 826

• **PATENT ABSTRACTS OF JAPAN vol. 8, no. 95**
(E-242)(1532) 2 May 1984 & JP-A-59 013 474

EP 0 388 936 B1

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

BACKGROUND OF THE INVENTION

The present invention relates to an image pickup device, and more particularly to the image pickup device which is capable of producing an excellent image if an image is picked up in a fluctuating state.

In recent days, as the users of an image pickup device become more and more, unskilled persons may more often handle the image pickup device, in addition, the image pickup device is likely to raise its zooming magnification.

It is likely that the unskilled persons, however, cannot firmly keep the image pickup device with their hands when they use it for picking up an image. And, even skilled persons may not firmly keep the image pickup device if they use the device with a high zooming magnification. The resulting images may be so vibrated that they become obscure. Moreover, when a user picks up an image on a moving place such as a car, the resulting images also may be often so vibrated that they become obscure.

There has been required an image pickup device which is capable of producing an excellent image when the device is handled in a fluctuating state.

Under those circumstances, there have been heretofore developed techniques for stabilizing a fluctuated image. One of such stabilizing techniques will be discussed below.

One of the conventional stabilizing techniques has been proposed in the JP-A-61198879. Fig. 1 is a block diagram showing an image pickup device employing the technique for correcting the fluctuated image. Fig. 2 is a schematic illustration for describing the operation of the image pickup device to which the technique is applied.

As shown in Fig. 1, 1 is an image pickup means, 2 is a motion vector detector, 3 is a field memory, and 4 is a readout position control means. As shown in Fig. 2, 5 is an image represented by a video signal sent from the image pickup means 1, 6 and 6' are screens displaying images of the current field and the previous one read out from the field memory 3, 7 and 7' are images of the current and previous fields displayed on the screens, and 8 is a motion vector. A following description will be directed to the operation of the image pickup device employing the fluctuated image stabilizing technique as designed above.

At first, the image pickup means 1 outputs a video signal. The screen 5 represented by the video signal is shown in Fig. 2. The field memory 3 stores a one-field portion of the video signal. The motion vector detector 2 serves to detect parallel movement (referred to as a motion vector) of an image in the current field against the image in the previous field on screen out of the video signal. The motion vector is indicated by 8 in Fig. 2. The readout position control means 4 serves to shift the po-

sition at which the video signal is a read out of the field memory 3 for stabilizing the motion, based on the motion vector detected from the motion vector detector 2, such that the position is shifted from numerals 7 to 7' shown in Fig. 2.

If, therefore, the image pickup device handled in a fluctuating state results in producing fluctuated images indicated by 7 and 7' in Fig. 2, the movement of the images 7 to 7' can be relatively stabilized against the screens 6 and 6' represented by an video signal read out by the field memory 3. The stabilization provides an image formed as if the image pickup device were not fluctuated.

The foregoing image pickup device, however, can stabilize the fluctuation field by field but cannot stabilize a blurred image resulting from in-field fluctuation of the device. Hence, though the position of an image on screen is not moved, the blurring generated on edge portions of the image is varied, resulting in often generating a visually unnatural image.

Fig. 3 are graphs for describing the foregoing disadvantage. Fig. 3a is a graph indicating how a point placed on an optical image is moved if an image is picked up in a fluctuating state. Fig. 3b is a graph indicating how a point on the image at each field matching to the point movement shown in Fig. 3a is changed. Fig. 3c is a graph indicating fluctuation-stabilized images. As shown in Fig. 3a, if the image pickup device handled in a fluctuating state results in moving a point on the image, the point on the image at each field is moved between two fields 24 and it is blurred within each field itself in proportion to the speed of a point movement 22. (Hereinafter, the between-field movement 24 of the image is referred to as fluctuation and the in-field image blurring 22 is referred to as a blurring.)

If the image is fluctuation-stabilized, as shown in Fig. 3c, the point on the image stays on its position but is subject to the blurring 22 in proportion to the fluctuating speed of the image pickup device.

As shown in Fig. 3b, if the blurring 22 caused on an image at each field has the visually same direction as the between-field movement 24 of an image, the image is recognized as a natural motion picture. As shown in Fig. 3c, if the blurring 22 is caused to change in proportion to the speed at which the image pickup device is fluctuated, the image is recognized as a quite unnatural image even if the between-field movement of the image is stabilized and the image remains motionless.

As has been mentioned above, the image pickup device employing the conventional fluctuation-stabilizing technique causes a blurring mismatched to the between-field movement even on the stabilized image, resulting in producing a quite unnatural and unappreciable image from a visual point of view.

JP-A- 59 013 474 discloses control means for controlling an exposure time in order to reduce a blur of a target image within one frame of a stationary image or a moving image.

GB-A-2 164 225 discloses a device for use in high resolution stabilized imaging systems. The imaging system comprises mechanical means for stabilizing unnecessary fluctuation of the image output and exposure control means for reducing the exposure time to substantially less than one field period.

It is an object of the present invention to provide an image pickup device which is capable of producing a natural and appreciable image even if an image is picked up in a fluctuating state by an unskilled person or from a moveable point such as a car.

To achieve the above object, according to a first aspect of the invention, there is provided an image pickup device comprising an image pickup means, control means for controlling an exposure time used for said image pickup means to be shorter than one field, and stabilizing means for detecting a motion vector and for stabilizing unnecessary fluctuation of an image output by said image pickup means, wherein said stabilization means is adapted to perform a predetermined image processing including stabilizing the image by shifting it over a distance equal to the product of the detected motion vector and a stabilization reference value, said stabilization reference value being dependent on said exposure time.

According to a second aspect of the invention, there is provided an image pickup device, comprising image pickup means, stabilizing means for detecting a motion vector and for stabilizing unnecessary fluctuation of an image output by said image pickup means according to a stabilization reference value, control means for controlling an exposure time used for said image pickup means according to an exposure time reference value, and computing means for computing said stabilization reference value in dependency on said exposure time reference value or said exposure time reference value in dependency on said stabilization reference value, wherein said stabilization means is adapted to perform a predetermined image processing including stabilizing the image by shifting it over a distance equal to the product of the detected motion vector and said stabilization reference value.

Preferably, the above-mentioned computing means employs two stabilization reference values of ON or OFF indicating whether it is stabilized or not, and if said value is selected as ON, the exposure time reference value is computed in a manner to allow the exposure time to be a predetermined time or less.

Said computing means may also serve to compute the stabilization reference value based on the exposure time reference value, of vice versa.

Finally, said computing means may be adapted to perform the computation of said stabilization reference values so that a predetermined fluctuating amount remains in said image output by said stabilizing means.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing an image pickup device to which a conventional fluctuation stabilizing technique is applied;

Fig. 2 is a schematic illustration for describing the operation of an image pickup device according to the prior art;

Figs. 3a, b, c are graphs for describing the above;

Fig. 4 is a block diagram showing an image pickup device according to a first embodiment of the invention;

Figs. 5a, b, and c are graphs for describing the operation of an image pickup device according to the first embodiment;

Fig. 6 is a block diagram showing an image pickup device according to a second embodiment of the invention;

Fig. 7 is a block diagram showing an image pickup device according to a third embodiment of the invention;

Fig. 8 is a graph showing relation between an exposure time and a fluctuation-stabilizing reference value in a computing means 12 according to the third and the fourth embodiment of the invention;

Figs. 9 and 10 are graphs for describing the operation of the image pickup device according to the third embodiment of the invention;

Fig. 11 is a graph showing relation between an exposure time and a fluctuation-stabilizing reference value used in a computing means 12 according to fluctuations of the third and the fourth embodiments of the invention;

Fig. 12 is a graph showing relation between a motion vector and a stabilization in a fluctuation stabilizing means 11 according to fluctuations of the third and the fourth embodiments of the invention;

Fig. 13 is a block diagram showing an image pickup device according to the fourth embodiment of the invention;

Fig. 14 is a block diagram showing an image pickup device according to a fifth embodiment of the invention; and

Fig. 15 is a graph showing relation among an exposure time, a magnitude of a motion vector, and a stabilization reference value used in a computing means according to the fifth embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A description will be directed to one embodiment of the invention with reference to the drawings.

Fig. 4 is a block diagram showing an image pickup device according to a first embodiment of the invention. As shown, 1 is an image pickup means, 11 is a fluctuation stabilizing means, and 13 is an exposure time con-

trol means.

The operation of an image pickup device according to the first embodiment designed above will be described as follows.

At first, the exposure time control means 13 serves to control an exposure time of the image pickup means 1 (a storage time given when a one-field portion of a video signal is picked out of an optical image) to be 1/240 sec.

Then, the image pickup means sends a video signal to the fluctuation stabilizing means 11. The fluctuation stabilizing means 11 serves to detect a motion vector for an overall screen from the video signal, correct an unnecessary fluctuation component of an image, and output the resulting signal.

Figs. 5a, b, and c are graphs for describing the operation of this embodiment. Fig. 5a indicates the movement of a point on an optical image given when a camera is not firmly kept in picking up an image. Fig. 5b indicates the resulting image at each field. Fig. 5c is a fluctuation-stabilized image. As shown in Fig. 5a, if the fluctuation of the image pickup device results in causing movement of a point on the image, the point on the image at each field provided by the image pickup means, as shown in Fig. 5b, is shifted as shown by 24. At the same time, a blurring 22 is caused within an image at each field, where the magnitude of the blurring 22 is proportional to a product of the fluctuating speed of the image pickup device and the exposure time 23. By controlling the exposure time to be 1/240 sec, therefore, it is possible to suppress the blurring to be quarter as much as that given in case of 1/60 sec, thereby suppressing the blurring 22 of the image for one field to be 1/4. The point on the fluctuation-stabilized image results in being a visually appreciable one, as shown in Fig. 5c.

As has been described above, according to the present embodiment, the fluctuation stabilizing means stabilize the fluctuation of an image at each field. The exposure time control means then controls the exposure time for suppressing a blurring of an image at each field to a small value, resulting in also suppressing visually unnatural factors of an image, thus, forming an excellent fluctuation-stabilized image.

Fig. 6 is a block diagram showing an image pickup device according to a second embodiment of the invention. As shown, 1 is an image pickup means, 11 is a fluctuation stabilizing means, 12 is a computing means, 13 is an exposure time control means, and 14 is a fluctuation stabilizing switch signal.

The operation of the second embodiment designed above will be described below.

At first, a user selects an on or off mode of a fluctuation stabilization switch signal. Then, the signal is input to the computing means 12. The computing means 12 serves to switch on a stabilization reference value if the stabilization switch signal is switched on and control the exposure time reference value to change the exposure time to 1/240 sec. It serves to switch off the stabilization

reference value if the stabilization switch signal is off and control the exposure time reference value to change the exposure time to 1/60 sec. Each stabilization reference value is outputted to the fluctuation stabilizing means 11 and the exposure time reference value is output to the exposure time control means 13.

The exposure time control means 13 serves to control an exposure time of the image pickup means 1 according to the exposure time reference value obtained by the computing means 12. The image pickup means 1 outputs a video signal to the fluctuation stabilization means 11.

And, the exposure time control means 13 serves to control an exposure time of the image pickup means 1 according to the exposure time reference value provided by the computing means 12. Then, the image pickup means 1 outputs a video signal to the fluctuation stabilizing means 11.

The fluctuation stabilizing means 11 serves to detect a motion vector of an overall screen out of the video signal. If the stabilization reference value provided by the computing means 12 is switched on, the means 11 serves to stabilize the fluctuating components of the image. If it is switched off, it serves to output the video signal without stabilizing the fluctuation components of the image.

If the stabilizing switch signal 14 is switched on, therefore, the present embodiment functions in a similar manner to the first embodiment of the invention. It means that the blurring of an in-field image is suppressed to be 1/4 by controlling the exposure time of the image pickup means 1. It is, therefore, possible to suppress visually unnatural factors of an image. If the stabilizing switch signal 14 is switched off, the exposure time becomes 1/60 sec which is four times as long as that given if the signal 14 is switched on, resulting in producing an excellent image with a little noise in a gloomy place.

As has been mentioned above, according to the present embodiment, by controlling the exposure time according to an on or off switching of the fluctuation controlling signal, it is possible to produce an excellent image with a little noise in a gloomy place. And, by stabilizing the fluctuation of the image, it is also possible to suppress the in-field blurring of the image to a small amount and suppress visually unnatural factors of the image, resulting in producing an excellent fluctuation-stabilized image.

Hereinafter, a third embodiment of the invention will be described. Fig. 7 is a block diagram showing an image pickup device according to a third embodiment of the invention. As shown, 1 is an image pickup means, 11 is a fluctuation-stabilizing means, 12 is a computing means, 13 is an exposure time control means, 14 is a fluctuation stabilizing switch signal, and 15 is an exposure time setting signal.

The operation of the image pickup device according to the third embodiment designed above will be de-

scribed below.

At first, a user selects an on or off mode of the fluctuation stabilizing switch signal 14. Then, the selected signal is input to the computing means 12. And, a value of the exposure time set by the user is input to the computing means 12 as an exposure time setting signal 15.

The computing means 12 serves to output the exposure time setting signal 15 to the exposure time control means 13 as an exposure time reference value. The computing means 12 serves to compute a stabilization reference value to match to the graph of the relation shown in Fig. 8, based on the input exposure time setting signal 15 if the stabilization switching signal 14 is switched on. Then, the resulting value is output to the stabilizing means 11. If the stabilization switching signal 14 is off, the stabilization reference value is output as zero to the stabilizing means 11.

And, the exposure time control means 13 serves to control an exposure time of the image pickup means 1 according to the exposure time reference value output by the computing means 12. The image pickup means 1 serves to output a video signal to the fluctuation stabilizing means 11.

The fluctuation stabilizing means 11 serves to detect a motion vector for an overall screen from the input video signal and stabilize the image by a product of the motion vector and a stabilizing reference value given by the computing means 12, then outputting the resulting signal.

Figs. 9a, b, and c are graphs for describing the operation of the present embodiment assumed that the stabilization switching signal 14 is switched on and the exposure time setting signal 15 suppresses the exposure time to 1/60 sec. Fig. 9a indicates how a point on an optical image is moved if the image is picked up in a fluctuating state. Fig. 9b indicates an image at each field given in the case of Fig. 9a. Fig. 9c indicates a fluctuation-stabilized image. As shown in Fig. 9a, the image pickup device handled in a fluctuating state results in moving the point on the image. In this case, on the image at each field sent from the image pickup means, as shown in Fig. 9b, the point position is moved as well as the blurring of the image at a field is brought about. Since the exposure time reaches 1/60 sec, the computing means 12 serves to compute a stabilizing reference value as 0.5 as shown in Fig. 8. The in-field fluctuation of the point formed on the fluctuation-stabilized image is stabilized by a product of a motion vector and 0.5 as shown in Fig. 9c. The stabilized image has the remaining fluctuation in the same direction of blurring for one field, said fluctuation matching to a product of the original fluctuation and the stabilization reference value of 0.5. On the stabilized image, the fluctuation at each field is substantially same as the blurring for one field in direction and magnitude. It results in suppressing visually unnatural factors of an image and producing a visually natural image.

Figs. 10a, b, and c are graphs for describing the op-

eration of the present embodiment assumed that the stabilization switching signal 14 is switched on and the exposure time setting signal 15 serves to suppress an exposure time as 1/240sec. Fig. 10a indicates how a point on an optical image is moved if an image is picked up in a fluctuating state. Fig. 10b indicates an image at each field given in the case of Fig. 10a. Fig. 10c indicates a fluctuation-stabilized image. As shown in Fig. 10a, the image pickup device handled in a fluctuating state results in moving the point on the image. In this case, on the image at each field sent from the image pickup means, as shown in Fig. 10b, the point position is moved as well as the blurring of the image at a field is brought about in proportion to the exposure time. Since the exposure time reaches 1/240 sec, the computing means 12 serves to compute a stabilization reference value as 0.875 as shown in Fig. 8. The in-field fluctuation is stabilized by a product of a motion vector and 0.875 as shown in Fig. 10c. The stabilized image has the remaining fluctuation of 0.125 oriented in the direction of the blurring for one field. On the stabilized image, the fluctuation at each field is substantially same as the blurring for one field in direction and magnitude. It results in suppressing visually unnatural factors of an image and producing a visually natural image.

As has been mentioned above, according to the present embodiment, the computing means serves to compute how much of fluctuation is stabilized according to the set exposure time. If the exposure time is variable, therefore, the blurring for one field is matched in direction and magnitude to the fluctuation at each field, resulting in suppressing visually unnatural factors of an image and producing an excellent fluctuation-stabilized image.

A fourth embodiment of the present invention will be discussed below. Fig. 13 is a block diagram showing an image pickup device according to the fourth embodiment. As shown, 1 is an image pickup means, 11 is a fluctuation-stabilizing means, 12 is a computing means, 13 is an exposure time control means, and 14 is a fluctuation stabilization switching signal.

The operation of the image pickup device according to the fourth embodiment designed above will be discussed below.

At first, a user may select any mode of 95%, 90%, 75%, 50%, and off for the fluctuation stabilization switching signal 14. The selected signal is input to the computing means 12.

The computing means 12 serves to select any stabilization reference value of 0.95, 0.9, 0.75, 0.5, and 0 according to the selected mode of 95%, 90%, 75%, 50%, and off and output the selected value to the stabilizing means 11. Based on the selected stabilization reference value, the exposure time reference value is computed and then output to the exposure time control means 13 in a manner to match to the relation graph shown in Fig. 8.

The exposure time control means 13 serves to con-

control the exposure time of the image pickup means 1 according to the exposure time reference value provided by the computing means 12. The image pickup means 1 serves to output a video signal to the stabilization controlling means 11.

The fluctuation stabilizing means 11 serves to detect a motion vector for the overall section based on the video signal being input and to stabilize and output the fluctuation of the image by a product of the detected motion vector and the stabilization reference value sent from the computing means 12.

According to the present embodiment, like the third embodiment, on the constantly fluctuation-stabilized image, the blurring for one field is matched in direction and magnitude to the fluctuation of the image at a field, resulting in suppressing visually unnatural factors of an image and producing an excellent fluctuation-stabilized image. In addition, a user can freely select how much of fluctuation is stabilized, that is, a stabilized fluctuation amount using the fluctuation stabilization switching signal 14.

A fifth embodiment of the invention will be discussed below.

Fig. 14 is a block diagram showing an image pickup device according to the fifth embodiment. As shown, 1 is an image pickup means, 11 is a fluctuation stabilizing means, 12 is a computing means, and 13 is an exposure time control means.

A description will be directed to the operation of the image pickup device according to the fifth embodiment designed above. The exposure time control means 13 serves to control the exposure time of the image pickup means 1 according to the exposure time reference value being inputted. Then, the image pickup means 1 serves to output a video signal to the fluctuation stabilizing means 11.

The fluctuation stabilizing means 11 serves to detect a motion vector for the overall screen using the input video signal and stabilize and output the fluctuation of the image by a product of the detected video signal and the stabilization reference value provided by the computing means 12.

Then, a description will be directed to a procedure of the computing means 12 for computing an exposure time reference value and a fluctuation stabilization reference value

The computing means 12 receives a quantity of light of an object to be imaged from the image pickup means 1 and a magnitude of a motion vector from the fluctuation stabilizing means 11. At first, it derives a minimum exposure time required for imaging at a sufficient S/N ratio based on the received quantity of light. Next, according to the magnitude of the motion vector, it serves to derive a longer exposure time if a maximum value of the magnitudes of the motion vectors at the several previous fields is smaller than a maximum value of the minimum exposure time and a shorter exposure time if it is larger and then output the result to the exposure time

control means 13. And, based on the exposure time reference value computed at this step and the magnitude of the motion vector, it serves to derive a stabilized fluctuation amount against the motion vector as shown in Fig. 15 and output the result to the fluctuation stabilizing means 11.

According to the present embodiment, the magnitude of blurring for one field is proportional to a product of an exposure time and a magnitude of a motion vector. By controlling an exposure time according to a maximum value of the magnitudes of the motion vectors, therefore, it is possible to constantly keep the magnitude of a blurring constant or less. If the quantity of light of an object to be imaged is not enough, it is possible to keep an S/N ratio of an image constant or more. Hence, if the magnitude of a blurring exceeds a constant value, it is possible to match the blurring to the fluctuation on the stabilized image by controlling the stabilized fluctuation amount, resulting in producing a visually natural image.

According to the first to fifth embodiments, the fluctuation stabilizing means has been designed to derive a motion vector for an overall screen from a video signal. Yet, an acceleration sensor or gyroscope may be provided for sensing how an image pickup device is fluctuated. On the sensed fluctuation, the fluctuation stabilizing means serves to derive a motion vector for an overall screen resulting from the fluctuated image pickup device.

According to the first and the second embodiments, though the exposure time required for fluctuation stabilization is 1/240 sec, the time is effective if it is shorter than a one-field time. And, the exposure time may be easily selected by a user. It is to be noted that the exposure time is automatically selected to 1/500 sec if the fluctuation is stabilized and then it may be optionally reset by a user.

Further, according to the first and the second embodiments, the fluctuation stabilization is done for stabilizing unnecessary fluctuating components of an image. However, by intentionally leaving a small amount of fluctuating components without stabilizing all the fluctuating components, it is possible to match the blurring for one field to the fluctuation at each field in direction and magnitude on a fluctuation-stabilized image, resulting in further suppressing visually unnatural factors of an image.

According to the third embodiment, the user can set the exposure time setting signal 15. However, the exposure time setting signal 15 can be automatically set depending on brightness of an object to be imaged. In this instance, what the user should do is merely to select any mode of the fluctuation stabilization switching signal 14, resulting in producing a natural image about the fluctuation and the blurring of an image and with a little noise.

According to the third and the fourth embodiments, the relation between the exposure time and the fluctuation stabilization reference value may be nonlinear. As

shown in Fig. 11, for example, the relation between the exposure time and the fluctuation-stabilization reference value may take three types of 16, 17, 18, one of which can be selected by a user. If the relation 16 is selected, on the fluctuation-stabilized image, the blurring for each field is relatively larger than the fluctuation at a field, so that the blurred image may visually appear like a lag. Yet, a great effect for stabilizing fluctuation is provided. If the relation 18 is selected, an effect for stabilizing fluctuation is made smaller, but the blurred image may not visually appear like a lag. Accordingly, it is very convenient for a user to select any of these relations depending on the circumstance and his preference.

According to the third and the fourth embodiments, the fluctuation stabilizing means has been designed to stabilize the fluctuation by a product of a motion vector and a stabilization reference value. The resulting relation between the motion vector and the stabilized fluctuation is linear as shown by 19 in Fig. 12. The ratio of the stabilized fluctuation 19 to the remaining fluctuation 21 is kept constant. The relation, however, may be non-linear as shown by 20 in Fig. 12. As the motion vector becomes larger, the ratio of the stabilized fluctuation 20 to the remaining fluctuation 21 is made larger, resulting in causing a more natural blurring for a field on the stabilized image.

In the aforementioned embodiments, the common references have the same numerals.

According to the fifth embodiment, the exposure time used for the exposure time control means 13 and the image pickup means 1 may be a continuous value being smoothly changed and a discrete value being switched. If the exposure time is a discrete value being switched, a video signal level at the exposure time switching time does not change serially. For stabilizing this disadvantageous change, however, the image pickup means 1 may change a gain of a video signal in a stepwise manner.

Further, by employing the constructions for performing the quite same operation as the third to the fifth embodiments, it is possible to switch these constructions to a preferable one depending on the circumstance and user's preference.

According to the second to the fifth embodiments, when the computing means 12 derives a stabilization reference value and an exposure time reference value, there have been used some factors such as a stabilization switching signal, an exposure time setting signal, a quantity of light of an object to be imaged, and a magnitude of a motion vector. In addition to them, some other values may be easily used. For example, a zoom magnification or a diaphragm value may be used. In addition, the computing means may be realized with an actual circuit or software run in a microcomputer.

As has been mentioned earlier, by providing a fluctuation stabilizing means and an exposure time control means, the fluctuation of an image and the blurring of a

one-field image may be suppressed to a minimum even if an image is picked up in a fluctuating state of the image pickup device. It results in providing an image pickup device which can offer a visually natural image with little fluctuation.

Moreover, provision of a fluctuation stabilizing means, an exposure time control means, and a computing means for computing a stabilization reference value and an exposure time reference value for the fluctuation controlling means and the exposure time control means results in realizing an image pickup device which can offer an excellent image, that is, the image where the relation between the fluctuation of the image and the blurring of the one-field image seems visually natural even if an image is picked up when the image pickup device is handled in a fluctuating state.

Claims

1. An image pickup device, comprising an image pickup means (1), control means (13) for controlling an exposure time used for said image pickup means (1) to be shorter than one field, and stabilizing means (11) for detecting a motion vector and for stabilizing unnecessary fluctuation of an image output by said image pickup means, wherein said stabilization means (11) is adapted to perform a predetermined image processing including stabilizing the image by shifting it over a distance equal to the product of the detected motion vector and a stabilization reference value, said stabilization reference value being dependent on said exposure time.
2. An image pickup device, comprising image pickup means (1), stabilizing means (11) for detecting a motion vector and for stabilizing unnecessary fluctuation of an image output by said image pickup means (1) according to a stabilization reference value, control means (13) for controlling an exposure time used for said image pickup means (1) according to an exposure time reference value, and computing means (12) for computing said stabilization reference value in dependency on said exposure time reference value or said exposure time reference value in dependency on said stabilization reference value, wherein said stabilization means (11) is adapted to perform a predetermined image processing including stabilizing the image by shifting it over a distance equal to the product of the detected motion vector and said stabilization reference value.
3. The image pickup device claimed in claim 2, wherein the computing means (12) can employ two stabilization reference values of ON or OFF indicating whether it is stabilized or not, and if said value is selected as ON, the exposure time reference value

is computed in a manner to allow the exposure time to be a predetermined time or less.

4. The image pickup device claimed in claim 2 or 3, wherein the computing means (12) serves to compute the stabilization reference value based on the exposure time reference value, or vice versa.
5. The image pickup device claimed in any of claims 2 to 4, wherein the computing means (12) is adapted to perform the computation of said stabilization reference value so that a predetermined fluctuating amount remains in said image output by said stabilizing means (11).

Patentansprüche

1. Bildaufnahmeverrichtung, umfassend eine Bildaufnahmeeinrichtung (1), eine Steuereinrichtung (13), die die für die Bildaufnahmeeinrichtung (1) verwendete Belichtungszeit so steuert, daß sie kürzer als ein Halbbild ist, und eine Stabilisierungseinrichtung (11) zum Erfassen eines Bewegungsvektors und zum Stabilisieren von nicht notwendigen Schwankungen eines von der Bildaufnahmeeinrichtung ausgegebenen Bildes, bei welcher die Stabilisierungseinrichtung (11) so ausgelegt ist, daß sie eine vorbestimmte Bildverarbeitung ausführt, die das Stabilisieren des Bildes durch Verschieben desselben über eine Distanz einschließt, die gleich dem Produkt des erfaßten Bewegungsvektors und eines Stabilisierungsreferenzwertes ist, welcher Stabilisierungsreferenzwert von der Belichtungszeit abhängig ist.
2. Bildaufnahmeverrichtung, umfassend eine Bildaufnahmeeinrichtung (1), eine Stabilisierungseinrichtung (11) zum Erfassen eines Bewegungsvektors und zum Stabilisieren von nicht notwendigen Schwankungen eines von der Bildaufnahmeeinrichtung (1) ausgegebenen Bildes gemäß einem Stabilisierungsreferenzwert, eine Steuereinrichtung (13) zum Steuern einer für die Bildaufnahmeeinrichtung (1) verwendeten Belichtungszeit gemäß einem Belichtungszeitreferenzwert, und eine Berechnungseinrichtung (12) zum Berechnen des Stabilisierungsreferenzwertes in Abhängigkeit von dem Belichtungszeitreferenzwert oder des Belichtungszeitreferenzwertes in Abhängigkeit von dem Stabilisierungsreferenzwert, wobei die Stabilisierungseinrichtung (11) so ausgelegt ist, daß sie eine vorbestimmte Bildverarbeitung ausführt, die das Stabilisieren des Bildes durch Verschieben desselben über eine Distanz einschließt, die gleich dem Produkt des erfaßten Bewegungsvektors und des Stabilisierungsreferenzwertes ist.

3. Bildaufnahmeverrichtung nach Anspruch 2, bei welcher die Berechnungseinrichtung (12) zwei Stabilisierungsreferenzwerte EIN oder AUS verwenden kann, die angeben, ob eine Stabilisierung vorliegt oder nicht, und dann, wenn der Wert EIN gewählt wird, der Belichtungszeitreferenzwert in einer Weise berechnet wird, die erlaubt, daß die Belichtungszeit eine vorbestimmte Zeit oder weniger ist.

4. Bildaufnahmeverrichtung nach Anspruch 2 oder 3, bei welcher die Berechnungseinrichtung (12) dazu dient, den Stabilisierungsreferenzwert auf der Basis des Belichtungszeitreferenzwertes oder umgekehrt zu berechnen.

5. Bildaufnahmeverrichtung nach einem der Ansprüche 2 bis 4, bei welcher die Berechnungseinrichtung (12) zur Berechnung des Stabilisierungsreferenzwertes in der Weise ausgelegt ist, daß in dem von der Stabilisierungseinrichtung (11) ausgegebenen Bild ein vorbestimmtes Schwankungsausmaß verbleibt.

Revendications

1. Dispositif de prise de vues, comportant des moyens de prise de vues (1), des moyens de commande (13) pour commander un temps d'exposition utilisé pour lesdits moyens de prise de vues (1) pour que celui-ci soit inférieur à celui d'une trame, et des moyens de stabilisation (11) pour détecter un vecteur mouvement et stabiliser les fluctuations inutiles d'une image délivrée par lesdits moyens de prise de vues, dans lequel lesdits moyens de stabilisation (11) sont adaptés pour effectuer un traitement d'image prédéterminé incluant la stabilisation de l'image en la décalant d'une distance égale au produit du vecteur mouvement détecté et d'une valeur de référence de stabilisation, ladite valeur de référence de stabilisation dépendant dudit temps d'exposition.

2. Dispositif de prise de vues, comportant des moyens de prise de vues (1), des moyens de stabilisation (11) pour détecter un vecteur mouvement et stabiliser les fluctuations inutiles d'une image délivrée par lesdits moyens de prise de vues (1) en fonction d'une valeur de référence de stabilisation, des moyens de commande (13) pour commander un temps d'exposition utilisé pour lesdits moyens de prise de vues (1) en fonction d'une valeur de référence de temps d'exposition, et des moyens de calcul (12) pour calculer ladite valeur de référence de stabilisation en fonction de ladite valeur de référence de temps d'exposition ou ladite valeur de référence de temps d'exposition en fonction de ladite valeur de référence de stabilisation, dans lequel

lesdits moyens de stabilisation (11) sont adaptés pour effectuer un traitement d'image prédéterminé incluant la stabilisation de l'image, en la décalant d'une distance égale au produit du vecteur mouvement détecté et de ladite valeur de référence de stabilisation. 5

3. Dispositif de prise de vues selon la revendication 2, dans lequel les moyens de calcul (12) peuvent utiliser deux valeurs de référence de stabilisation d'un mode MARCHE ou ARRÊT indiquant si les fluctuations sont stabilisées ou non, et, si ladite valeur est sélectionnée en mode MARCHE, la valeur de référence de temps d'exposition est calculée de manière à permettre au temps d'exposition d'être établi à un temps prédéterminé ou inférieur à celui-ci. 10 15
4. Dispositif de prise de vues selon la revendication 2 ou 3, dans lequel les moyens de calcul (12) servent à calculer la valeur de référence de stabilisation sur la base de la valeur de référence de temps d'exposition, ou vice versa. 20
5. Dispositif de prise de vues selon l'une quelconque des revendications 2 à 4, dans lequel les moyens de calcul (12) sont adaptés pour effectuer le calcul de ladite valeur de référence de stabilisation, de sorte qu'une quantité fluctuante prédéterminée subsiste dans ladite image délivrée par lesdits moyens de stabilisation (11). 25 30

35

40

45

50

55

FIG. 1

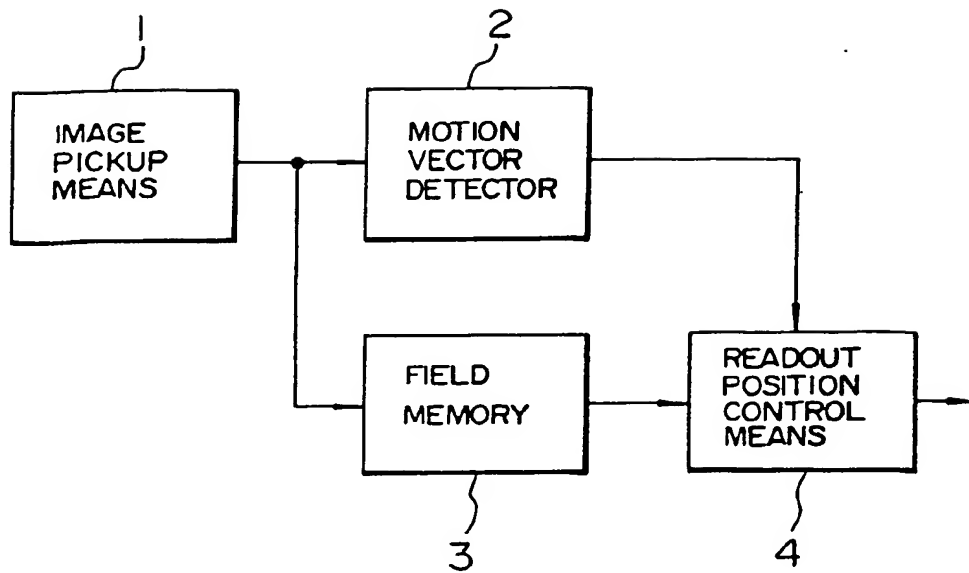


FIG. 2

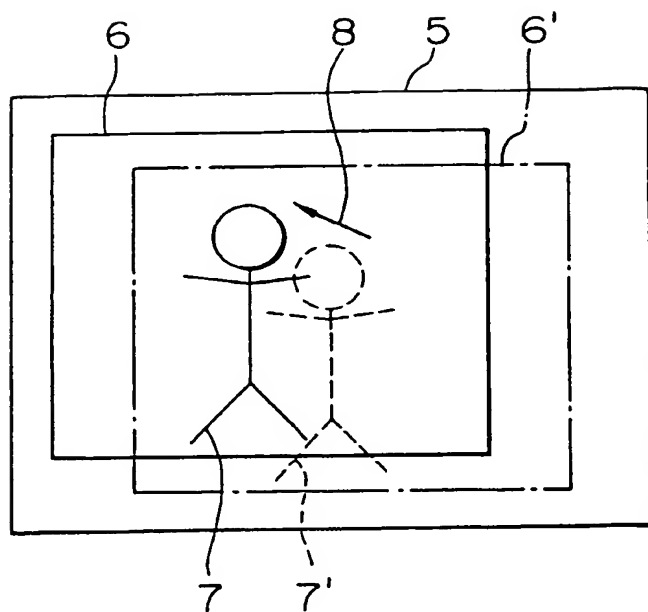


FIG. 3a

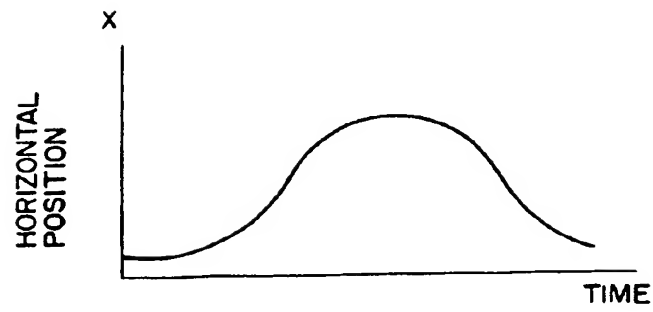


FIG. 3b

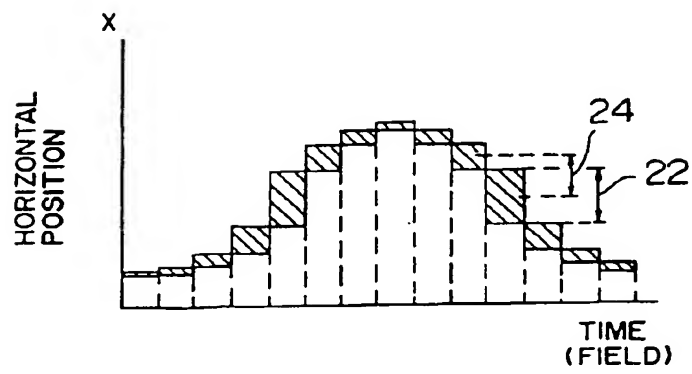


FIG. 3c

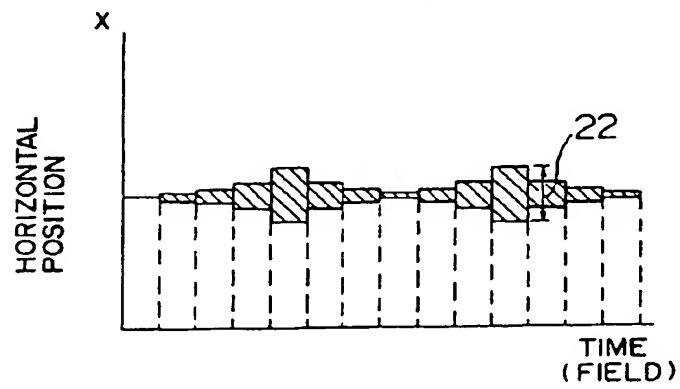


FIG. 4

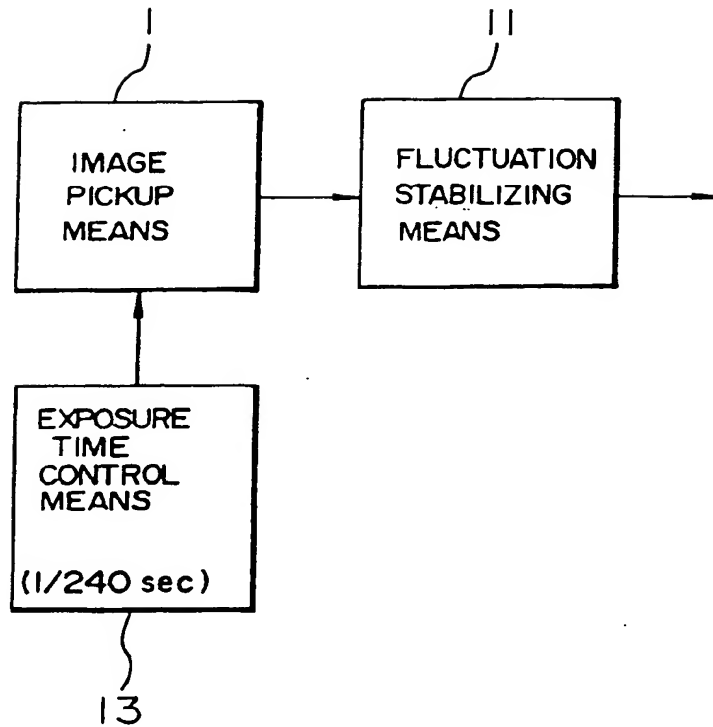


FIG. 5a

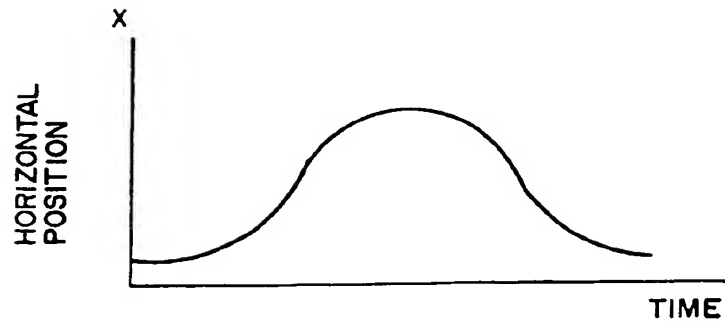


FIG. 5b

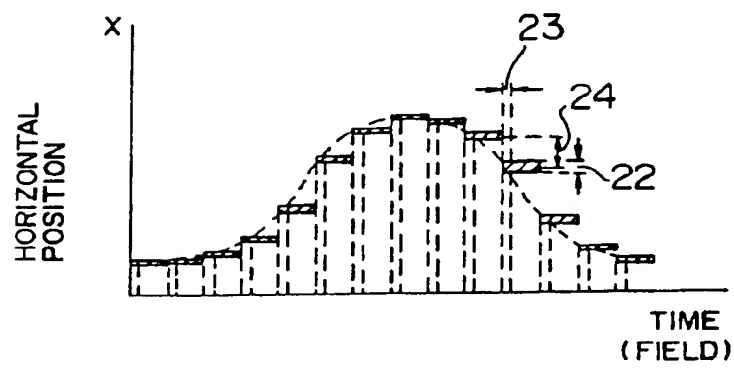


FIG. 5c

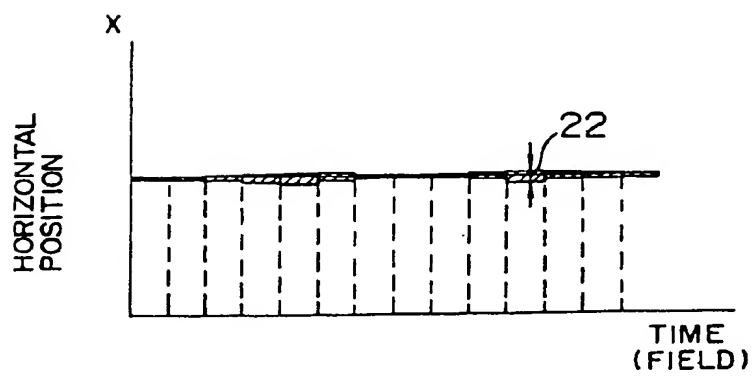


FIG. 6

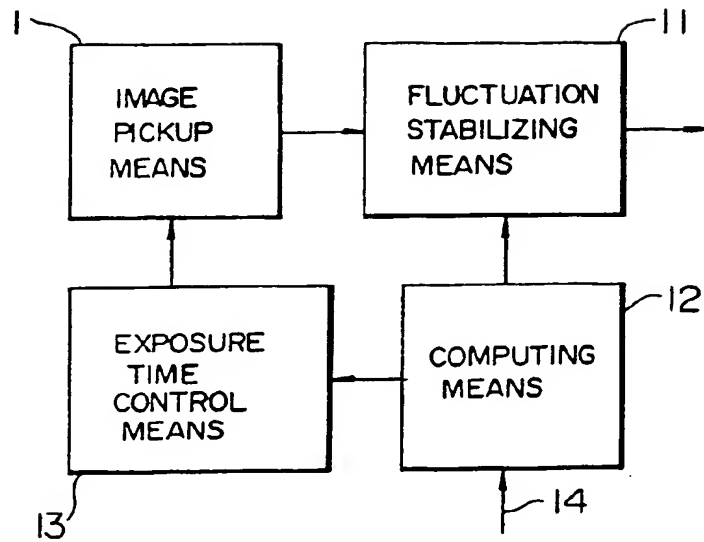


FIG. 7

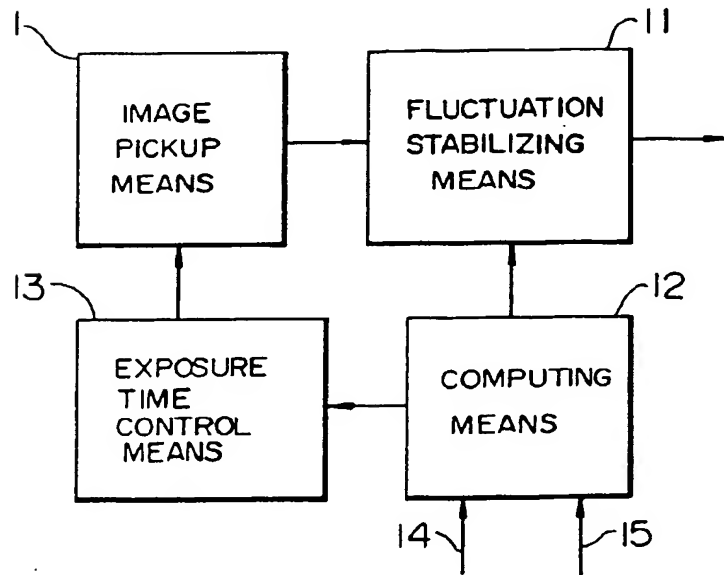


FIG. 8

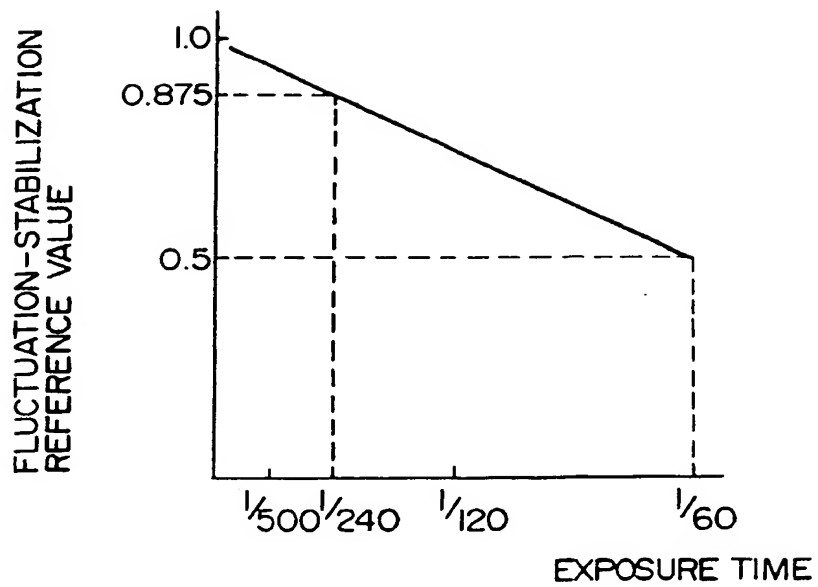


FIG. 9a

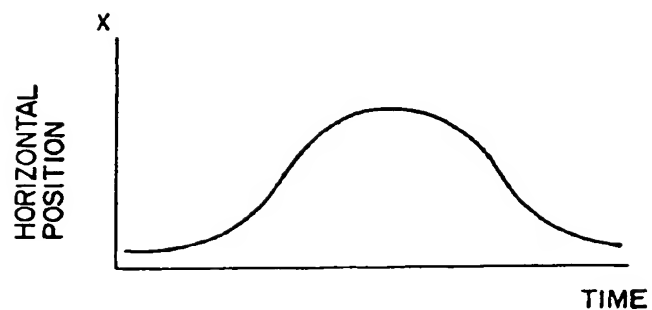


FIG. 9b

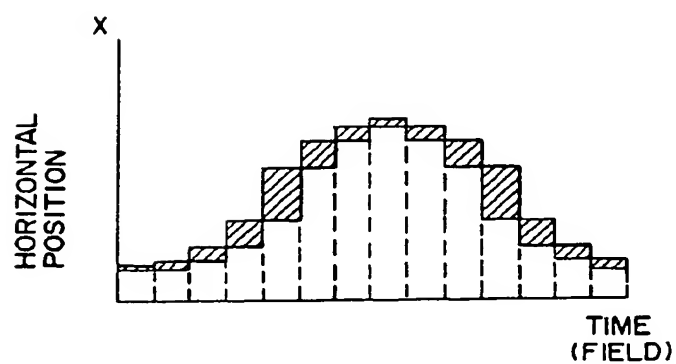


FIG. 9c

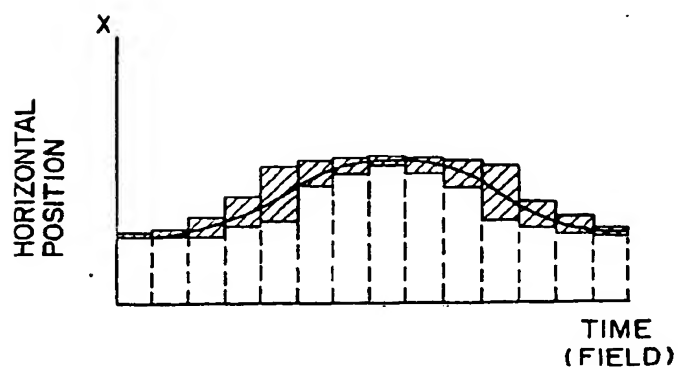


FIG. 10a



FIG. 10b



FIG. 10c

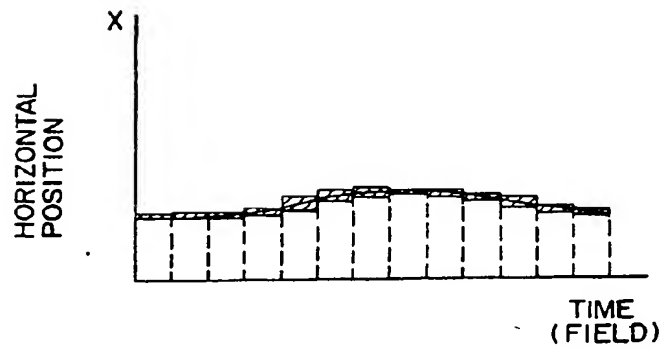


FIG. 11

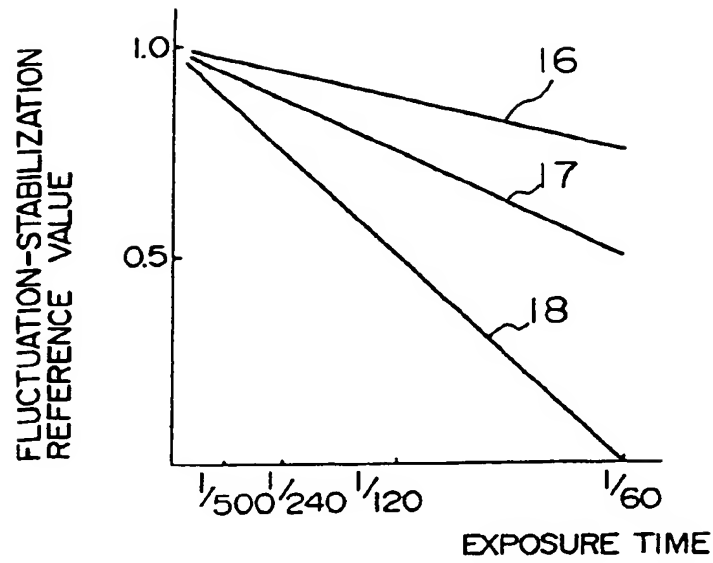


FIG. 12

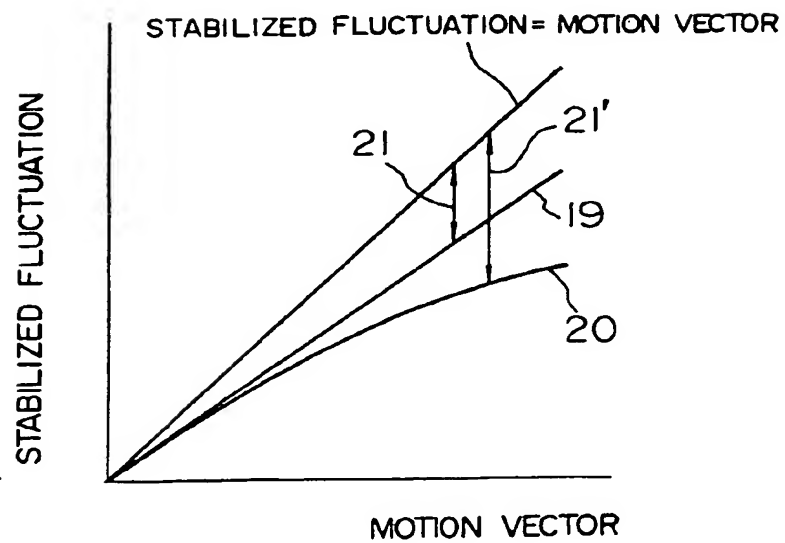


FIG. 13

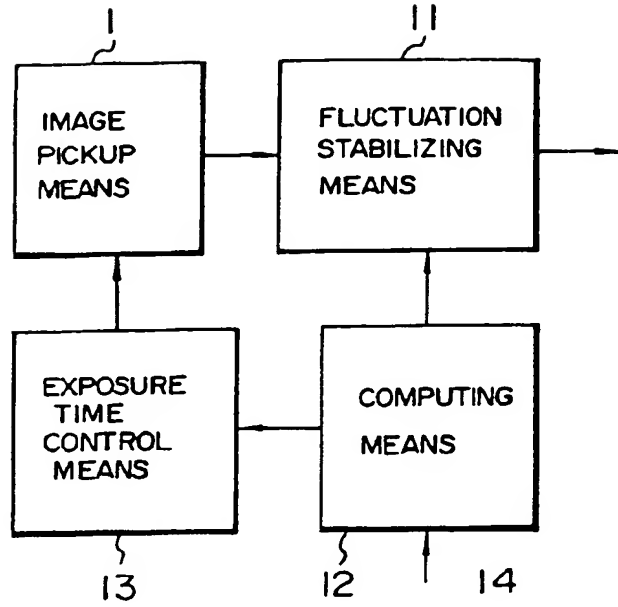


FIG. 14

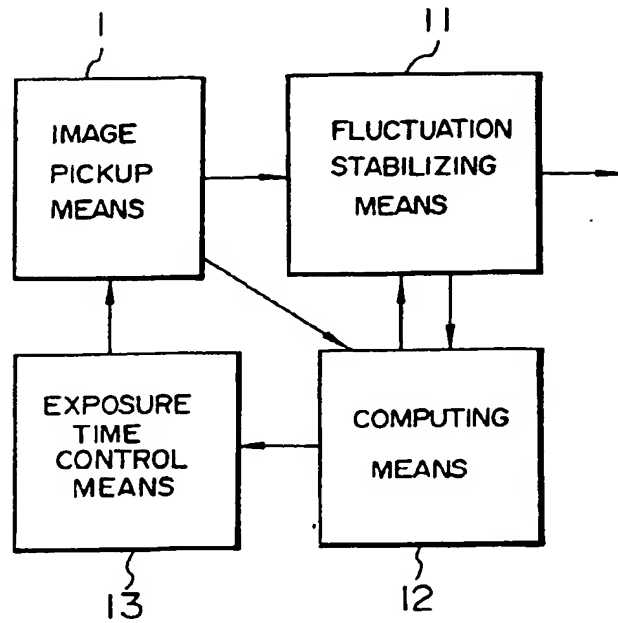
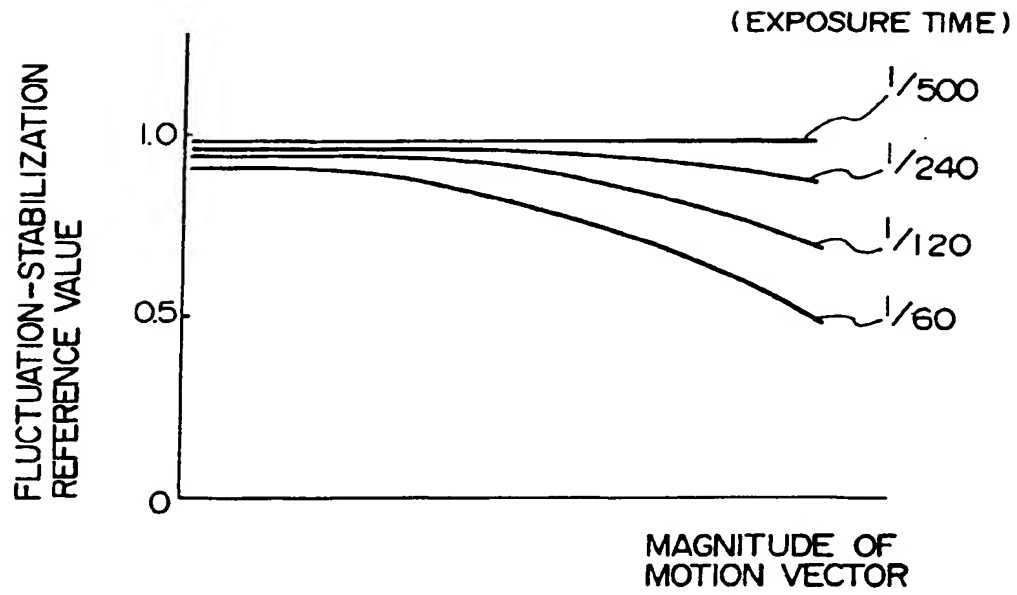


FIG. 15



**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☒ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.